REMARKS

Claims 1 - 16 are now pending in the application. The Examiner is respectfully requested to reconsider and withdraw the rejection(s) in view of the amendments and remarks contained herein.

Claims 1 and 13

Original claims 1 and 13 do not recite an inner structure of the shielding conductor. However, the present invention is based on an assumption that the interior is filled with a uniform dielectric material as shown in the embodiments and figures. It was already confirmed that a TM_{010} mode is available in such a structure as taught in Nishikawa et al. (USP 4,639,699). Thus, claims 1 and 13 are amended as mentioned above in order to more clearly distinguish from Nishikawa et al. The structure of the present invention can provide an easier method for fabricating the resonator compared to Nishikawa et al., in which a dielectric having a high dielectric constant is formed in the surroundings of a dielectric having a low dielectric constant at the center (see, for example, Fig. 15 of Nishikawa et al.). Moreover, the present invention is advantageous in that the resonator size can be decreased since it is filled with the dielectric. Decrease in resonator size is desirable because loss in the whole circuit can be reduced since wire lines for connecting to other circuit elements may be shortened.

Claim 2

In Nishikawa et al., the TM_{010} mode is used similarly as with the present invention. However, Fig. 15 of Nishikawa et al. shows that the dielectric constant of the

center dielectric is low and the outer dielectric constant is high (see column 10, line 10), and a conductive film is provided on the outer surface of the outer dielectric. In contrast, in the present invention, the center dielectric constant is high and the surrounding dielectric constant is set low. Hence, the structures are basically different. As to the effects, Nishikawa et al. aims to improve the temperature property in the resonator (such as the change of the temperature property of the resonance frequency). Therefore, in Fig. 15 of Nishikawa et al., the purpose of the dielectric cylinder having the low dielectric constant at the center is to fill the resonator up and reduce cavity. It is preferred, however, to keep cavity by using air as the dielectric having the low dielectric constant. As a result, the influence of humidity is eased (see column 10, line 30). On the other hand, the present invention allows the resonator to become smaller by providing a portion having the high dielectric constant at the center of the dielectric on which electric fields of a resonant mode concentrate. Furthermore, the current that flows in the surrounding shielding conductor is reduced and loss can also be reduced with concentration of the electric fields at or near the center. Hence, the present invention is also distinguished from Nishikawa et al. in the effect.

Turning to El-Sharawy, the dielectric resonator is based on an assumption of a TE mode resonator. In the TE mode, intensity of the electric field at the center of the dielectric is likely to be weak. Even if regions where the dielectric constant is low, such as with cavity, were provided at or near the center of the dielectric, the resonator frequency would barely be affected. However, other modes, such as the high order resonant mode, have the strong electric fields at or near the center, and thus these modes are greatly affected by the existence of cavity, and the resonator frequency may

be high. Therefore, the difference of frequency between the high order resonance mode and the base mode (TE mode) can be great, and it is not caused by unnecessary resonance, for example, when a filter is arranged. This is the most important effect of the structure disclosed in El-Sharawy.

Moreover, in Figs. 8 and 9 of El-Sharawy, a low dielectric constant material is arranged in the surroundings of a high dielectric constant material. In the structure, a hole is provided at the center of the high dielectric constant material and the effect thereby is obtained. Even in this case, the resonance in the TE mode is assumed as disclosed in the specification, and therefore it is clearly different from the effect obtained with the low dielectric constant material arranged in the surroundings of the high dielectric constant material as recited in claim 2 of the present invention.

In the TM_{010} mode of the present invention, the intensity of electric fields at or near the center of the dielectric is the strongest, and therefore the resonance frequency becomes low when the high region having the high dielectric constant is provided thereon. When the dielectric is designed according to the same resonance frequency, the effect of downsizing can be obtained, and the resonance frequency becomes lower for the other high order resonance modes. As a result, the difference of frequency between the high order resonance mode and the base mode (TE_{010} mode) can be great, and it is not caused by unnecessary resonance, for example, when a filter or the like is arranged.

In conclusion, the resonance mode in the present invention is different from that of El-Sharawy; both effects should be distinguished from each other. Therefore, it

cannot be recognized that claim 2 of the present invention is anticipated by combination of the cited references.

Claim 6

Amended claim 6 is a combination of original claims 6-9. In the resonance of the amended claim 6, electrical contact between the case body and the conductive foil is easily obtained by situating the conductive foil between the elastic film and the case body. In the present invention, a case is composed of the case body and the conductive foil. Furthermore, in the TM mode, electrically bad contact between each portion in the case causes increase of loss of resonance. Thus, in the resonance claimed, a good Q value can be easily obtained, and at the same time it is meritable that both ends of the dielectric can be easily fixed to the bottom of the case body and the conductive foil in close contact therewith.

Claims 11 and 15

In claims 11 and 15, the conductor rod (in practice, metal screw) is inserted into the hole provided at the center of the columnar dielectric. Since the center of the dielectric has the strongest electric fields in the TM mode resonance, the resonance frequency can be effectively adjusted with insertion of the conductor. On the other hand, in Nishikawa et al., only the dielectric pillar portion is inserted into a hole provided in the dielectric (see Fig. 15). In this case, it is necessary to use a rod having a complicated structure with the dielectric mounted on top of the metal screw.

Therefore, the present invention is basically different from Nishikawa et al. in view of the structures. In the present invention, since a simple metal screw can be used, the structure becomes easier. Furthermore, the insertion of the metal has a larger influence on electric distribution, and thus the resonance frequency can be widely adjusted in the present invention.

Claim 12

Claim 12 is amended as the Examiner suggests. Since the structure is clearly distinguished from Nishikawa et al., it is believed that it recites patentable subject matter.

Claims 14 and 16

The structures are based on the resonance recited in claim 6. When amended claim 6 is recognized as reciting patentable subject matter, claims 14 and 16 should also recite patentable subject matter over the cited references.

CONCLUSION

It is believed that all of the stated grounds of rejection have been properly traversed, accommodated, or rendered moot. Applicant therefore respectfully requests that the Examiner reconsider and withdraw all presently outstanding rejections. It is believed that a full and complete response has been made to the outstanding Office Action, and as such, the present application is in condition for allowance. Thus, prompt and favorable consideration of this amendment is respectfully requested. If the

Examiner believes that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at (248) 641-1600.

Respectfully submitted,

Dated: November 20, 2002

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ATTACHMENT FOR CLAIM AMENDMENTS

The following is a marked up version of each amended claim in which underlines indicates insertions and brackets indicate deletions.

1. (Amended) A resonator comprising:

a columnar [dielectric] shielding case composed of a conductive material; and

[a shielding conductor surrounding the dielectric] a dielectric filled in the shielding case, the resonator using a resonant mode causing generation of a current crossing a corner of the columnar [dielectric,

wherein the shielding conductor is formed in direct contact with the surface of the dielectric] shielding case.

2. (Amended) the resonator of Claim 1, the resonator using a TM mode, wherein the dielectric includes a center portion and an outer portion covering at least part of the center portion, and the dielectric constant of the center portion is higher than the dielectric constant of the outer portion.

3. (Amended) The resonator of Claim 1, wherein the columnar [dielectric] shielding case is in a shape of a cylinder or a square pole.

4. (Amended) The resonator of Claim 1, wherein the shielding [conductor] case is a metallized layer formed on the surface of the dielectric.

6. (Amended) A resonator using a TM mode, the resonator comprising:

a case composed of a case body and a lid;

a dielectric fixed therein; [and

a case for housing the dielectric,

wherein part of the case is constructed of conductive foil and the conductive foil partly shields the dielectric electromagnetically]

an elastic layer sandwiched between the lid and the case body; and

conductive foil sandwiched between the elastic layer and the case body,

wherein lower and upper ends of the dielectric are respectively fixed to an inner face of a bottom of the case body and the conductive foil in contact therewith.

12. (Amended) A radio frequency filter comprising:

[a dielectric;]

a case body and a lid respectively composed of a conductive [a conductor member for electromagnetically shielding the dielectric] material;

[a conductor probe extending from a portion of the conductor member through a space defined by the conductor member to reach another portion of the conductor member, for coupling the dielectric with an external input signal or an external output signal]

a dielectric fixed therein, wherein a coaxial connector is placed on an outer surface of the case body,

a center conductor of the coaxial connector extends through an inner portion of the case body,

one end of a conductor probe is connected to the center conductor, and

another end of the conductor probe is connected to the lid.

14. (Amended) A radio frequency filter having a resonator using a TM mode, the resonator comprising:

a case composed of a case body and a lid;

a dielectric fixed therein; [and]

a case for housing the dielectric;

an elastic layer sandwiched between the lid and the case body; and

a conductive foil sandwiched between the elastic layer and the case body,

wherein lower and upper ends of the dielectric are respectively fixed to an inner face of a bottom of the case body and the conductive foil in contact therewith, and

part of the case is constructed of conductive foil and the conductive foil partly shields the dielectric electromagnetically.

16. (Amended) A radio frequency filter having a plurality of resonators at least including an input-stage resonator having a dielectric and receiving a radio frequency signal from an external device and an output-stage resonator having a dielectric and outputting a radio frequency signal to an external device, the radio frequency filter comprising:

a case surrounding the plurality of resonators for electromagnetically shielding the respective resonators,

wherein each of the input-stage resonator and the output-stage resonator comprise:

(a) a case body and a lid;

(b) a dielectric fixed therein;

(c) an elastic layer which is sandwiched between the lid and the case body; and

(d) conductive foil which is sandwiched between the elastic layer and the case body,

(e) wherein lower and upper ends of the dielectric are respectively fixed to an inner face of the bottom of the case body and the conductive foil in contact therewith,

a partition formed between resonators of which electromagnetic fields are coupled with each other among the plurality of resonators;

an input-stage coupling window formed at the partition; and

an input-stage coupling degree adjusting member made of a conductor rod for adjusting the area of the inter-stage coupling window.